December 6, 2006

SAMPLING AND ANALYSIS PLAN FOR INDOOR AIR OPERABLE UNIT 4 LIBBY, MONTANA, SUPERFUND SITE

Prepared by
US Environmental Protection Agency
Region 8
Denver, CO

With Technical Assistance from:

Syracuse Research Corporation
Denver, CO

and

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Denver, CO

APPROVAL PAGE

This Indoor Air and Dust Sampling Plan for Operable Unit 4 of the Libby, Montana, Superfund Site has been prepared by the U.S. Environmental Protection Agency, Region 8, with technical support from Syracuse Research Corporation and CDM, Inc.. Study activities addressed in this Plan are approved without condition.

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DOCUMENT REVISION LOG

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AHERA	Asbestos Hazardous Emergency Response Act
ASTM	American Society for Testing and Materials
BC	Berman Crump
BNSF	Burlington Northern Santa Fe
CI	Confidence Interval
CV	Coefficient of Variation
DF	Detection Frequency
DL	Detection Limit
EPA	Environmental Protection Agency
HEPA	High Efficiency Particulate Air
IRIS	Integrated Risk Information System
ISO	International Organization for Standardization
L	Dust Loading
LA	Libby Asbestos
PCME	Phase Contrast Microscopy Equivalent
PE	Performance Evaluation
PEF	Particulate Emission Factor
PLM	Polarized Light Microscopy
PLM-VE	PLM-Visual Estimation
QAPP	Quality Assurance and Project Plan
RAM	Real-time Particulate Monitors
RI	Remedial Investigation
ROD	Record of Decision
SEM	Scanning Electron Microscopy
SOP	Standard Operating Procedures
SUA	Special Use Areas
TAG	Technical Advisory Group
TAL	Target Analyte List
TEM	Transmission Electron Microscopy
USGS	United States Geological Survey
VI	Vermiculate Insulation
VCS	Vermiculite Containing Soil
XRD	X-Ray Diffraction

DRAFT
December 6, 2006

SAMPLING AND ANALYSIS PLAN FOR INDOOR AIR OPERABLE UNIT 4 LIBBY, MONTANA, SUPERFUND SITE

1.0 INTRODUCTION

This document is the Sampling and Analysis Plan (SAP) for the collection and analysis of samples of indoor air and potential sources of indoor air contamination at residential and commercial buildings located within Operable Unit 4 of the Libby, Montana, Superfund Site. Operable Unit 4 includes most current homes and businesses in the community of Libby.

This SAP contains the elements required for both a field sampling plan (FSP) and quality assurance project plan (QAPP). This SAP has been developed in accordance with the Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA 2001) and the Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4 (EPA 2006a). The SAP is organized as follows:

Section 1 - Introduction
Section 2 – Site Background and Problem Definition
Section 3 – Data Quality Objectives
Section 4 – Sampling Program, Rationale, and Locations
Section 5 – Laboratory Analysis and Requirements
Section 6 – Assessment and Oversight
Section 7 – Data Validation and Usability
Section 8 – Project Schedule
Section 9 – References

2.0 BACKGROUND AND PROBLEM DEFINITION

Libby is a community in northwestern Montana that is located near a large open-pit vermiculite mine. Vermiculite from this mine contains varying levels of a form of asbestos referred to as Libby Amphibole (LA). Historic mining, milling,, and processing operations at the site are known to have caused releases of vermiculite and LA to the environment that have caused a range of adverse health effects in exposed people, including not only workers at the mine and processing facilities (Amandus and Wheeler 1987, McDonald et al. 1986, McDonald et al. 2004), but also in residents of Libby (Peipens et al. 2003).

Starting in 2000, EPA began taking a range of cleanup actions at the site to eliminate sources of LA exposure to residents and workers. In the early stages, efforts were focused mainly on wastes remaining at former vermiculite processing areas (the screening plant, export plant, flyway, etc.). As work progressed, attention soon shifted to cleanup of current homes and workplaces in Operable Unit 4. The protocol that EPA developed for investigating sources of LA at specific properties and deciding when to take action is detailed in a Technical Memorandum issued in December 2003 (EPA 2003a). Cleanup actions taken under this protocol typically include removal of unenclosed vermiculite insulation (VI) from any living spaces and any other readily accessible spaces (e.g., unfinished attics), removal of some or all contaminated outdoor soils, and may, in some cases, include cleanup of indoor dusts.

Problem Definition

One issue of high priority to EPA is an evaluation of the efficacy of the current cleanup strategy. That is, answers are needed for the following questions:

- At a property that EPA has investigated and found no reason to take any cleanup actions, are the risks that remain sufficiently small to be considered acceptable?
- At a property where EPA has investigated and determined that one or more sources was present that required cleanup, are the risks that that remain after the cleanup is complete sufficiently small to be considered acceptable?

For convenience, in this document, the phrase "post-cleanup property" will be used to indicate any property where EPA has investigated sources and has either taken cleanup action or else tentatively determined that no cleanup action is needed.

Residual exposures and risks that may remain at post-cleanup properties may be divided into two main types:

- Exposures that occur inside the building
- Exposures that occur outside the building

This SAP is focused on an evaluation of the residual level of exposure and risk that may exist inside post-cleanup properties. Evaluation of residual risks from exposures that occur outside the building at post-clean-up properties are addressed in separate sampling plans.

Conceptual Model for Post-Cleanup Indoor Exposures

Cleanup actions at a property are intended to address any known indoor or outdoor sources that exceed the trigger levels specified in the Technical Memorandum (EPA 2003a). However, the cleanup strategy may leave some residual sources and exposure pathways in place. The residual sources that may impact indoor air at post-cleanup properties are discussed below.

Outdoor Air

All buildings exchange indoor air for outdoor air (ventilation). In warm weather, this may occur through open windows or doors. In cold weather, heating of indoor air creates a negative pressure inside the building, and this tends to draw outdoor air in through leaks and cracks in the building. Thus, even in the absence of any other sources, levels of LA in indoor air in a post-cleanup building are expected to be generally similar to the levels in outdoor air in that area.

Releases from Residual Indoor Sources

As noted above, if a building is found to contain unenclosed VI in an accessible area, that unenclosed VI is removed as part of the EPA cleanup action. Moreover, if any observable leakage of VI into indoor living space is observed, this area is also cleaned up. Finally, if indoor dust is found to contain more than 5,000 LA s/cm^2, the indoor dust is also cleaned up. Thus, under post-cleanup conditions, the residual indoor sources of LA contamination in indoor dust and indoor air may include: 1) trace levels of VI or LA from areas that have been cleaned,2) residual VI or LA in areas that have not been cleaned, including carpets, upholstery, air ducts, etc., and 3) VI that is presently contained in an intact structure (e.g., a wall).

Transport from Contaminated Areas of Yard Soil

Under the current cleanup protocol (EPA 2003a), outdoor soils are divided into "specific use areas" (SUAs) that include areas such as gardens and play areas where human exposure is likely to occur on a frequent basis, and "non-specific use areas" (NSUAs) that include general areas of

the yard where human exposure is likely to occur less frequently. At a post-cleanup property, no known vermiculite-containing soil (VCS) or LA is left in place in any SUA. However, in some cases, low levels of VCS or LA may be left in place in NSUAs. Thus, these areas of residual contamination in outdoor soil might serve as a source of contamination of indoor dust and indoor air.

Transport from Other Sources

In the past, transport of LA into homes may have occurred on the clothing of workers at the mine or processing areas. Likewise, transport may have occurred from readily accessible plies of waste vermiculite that were present at various locations around the community. Although the mine has ceased operation and EPA has removed the most important of the publicly accessible source areas, some smaller or less contaminated areas sources may still remain, and these could serve as a continuing source for contamination of indoor dust and indoor air.

3.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are statements that define the type, quality, quantity, purpose and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and the chemical analyses to be performed. In brief, the DQO process typically follows a seven-step procedure, as follows:

1. State the problem that the study is designed to address
2. Identify the decisions to be made with the data obtained
3. Identify the types of data inputs needed to make the decision
4. Define the bounds (in space and time) of the study
5. Define the decision rule which will be used to make decisions
6. Define the acceptable limits on decision errors
7. Optimize the design using information identified in Steps 1-6

Following these seven steps helps ensure that the project plan is carefully thought out and that the data collected will provide sufficient information to support the key decisions which must be made. The following paragraphs implement the DQO process for this project.

3.1. State the Problem

EPA has been working to clean up both indoor and outdoor sources of VI and LA at properties in OU4. Before final risk management decisions are made, information is needed to characterize the level of residual risk from indoor exposures that may remain at post-cleanup properties. Based on this, the primary objective of this effort is:

Primary Objective (Evaluation of Clean-Up Efficacy)

Evaluate the level of residual risk that occurs in indoor air at post-cleanup properties in order to determine if the current cleanup strategy is effective in providing public health protection. If some properties have residual risk above a level of concern, identity the most likely residual source(s) contributing to the contamination so that additional actions can be taken to investigate and minimize the remaining source(s).

While evaluation of risks from indoor air at any specific post-cleanup property may be assessed by direct assessment of indoor air samples from that property, it is desirable, if possible, to develop a method for predicting the level of risk from indoor air based on measurements of the

level and extent of known residual sources. If such a method can be developed and shown to yield reliable predictions, then this method may be used to compute risk-based concentrations (RBCs) of LA in various source materials, and this information can be used to help guide cleanup actions at the site. Based on this, the secondary objective of this effort is:

Secondary Objective (Develop Exposure Model)

Collect sufficient data on the level of LA in indoor air and in potential source media (e.g., indoor dust, outdoor soil , ambient air) that a quantitative model may be developed to predict indoor air levels from data on sources levels with sufficient accuracy to support cleanup and risk management decisions.

3.2. Identify the Decisions

The data to be collected during this effort are intended to support the following decisions:

1) Are current strategies for cleaning up properties in OU4 adequate to provide health protection from exposures in indoor air? If indoor air levels are above a level of concern in some post-cleanup buildings, what are the residual indoor or outdoor sources most likely to be responsible?

2) Do the data indicate a quantifiable relationship between the level and extent of LA in residual sources and the level observed in indoor air? If so, can long-term average exposure levels be predicted with sufficient accuracy to be useful in risk assessment and risk management decision-making?

Comment [dw1]:

Things we need to be thinking about:

If we find LA in indoor air – are we obligated to clean the inside of the home if the observed level is above the clearance criteria?

CURRENT LIVING SPACE CLEARANCE CRITERIA = ND ON 5 STATIONARY AIR SAMPLES.

Will we use personal air results to determine the need for "re-cleaning"? How quick will sample results be available – is it possible that a month after sample collection results indicate unacceptable exposures and homes must be re-cleaned? What happens at a property if more than one sampling event shows levels of LA requiring "re-cleaning"? Do we need to set –up interior containment to prevent our activities from possible redistributing LA in other areas of the home?

Comment [b2]: I think the answer is YES, if we find a condition that is deemed to be "unsafe", EPA will have to respond. The question is whether this document contains the definition of what is and is not acceptable. I think the issue of timing associated with sample analysis and evaluation is not problematic, since the risks would (presumably) not be ranked as time critical. Note that the description of the primary decision (Step 5, below) describes (qualitatively) what must happen if an exceedence is detected. Is this not enough?

3.3. Identify the Types of Data Needed

The data needed to achieve the primary objective of this effort consist of measures of LA in indoor air at a wide variety of post-cleanup properties. In order to achieve the secondary objective, data are also required on the types and levels of residual sources that may remain at each location. The following sections identify key attributes of the data needed for this effort.

Sampling Locations

Based on the current protocol for cleanup actions at a property, post-cleanup locations may be stratified into the following categories based on whether or not any outdoor soil cleanup actions were taken, and on what remains in outdoor soil post-cleanup:

Category	Outdoor Soil Cleanup Taken ?	Post-cleanup Surface Aoil		
		VCS		PLM Detect
1	No	-	and	-
2		+	or	+
3	Yes	-	and	-
4		+	and	-

In order to ensure that the set of post-cleanup properties selected for assessment in this effort are representative, the data set collected during this effort should include a number of properties from each category. This stratification will also help increase the ability to identify potential residual sources of concern if post-cleanup levels are found to exceed a level of health concern.

Types of Indoor Air Samples

There are a variety of different options for collecting samples of indoor air. Important variables include:

- Type of sampling device (personal *vs.* stationary monitor)
- Type of activity occurring during sampling

Table 3-1 summarizes data that EPA has collected to date at the Libby site on the importance of these variables. As seen, there is a clear tendency for personal air samples to yield higher concentration levels than stationary air samples, and there is a tendency for samples collected during cleaning activities to be higher than samples collected during routine indoor activities.

Although stationary air samples are generally more convenient to collect than personal air samples, because available data from the site indicate that stationary air samples tend to underestimate the true exposure of a person, this program will focus on the collection of personal air samples.

Indoor air samples may also be collected under a variety of differing activity scenarios, with varying levels of activity and source disturbance. While there is a very wide variety of such activities, it is not necessary to collect data under every possible combination of activity and source disturbance. Rather, for the purposes of this effort, samples should be representative of two generic conditions:

- Active behaviors
  This category includes a wide range of indoor activities in which a person is moving about the building and potentially disturbing indoor sources. For example, walking from room to room, sitting down on upholstered chairs, dusting, sweeping, moving furniture, etc, would all be included.

- Sedentary behaviors
  This includes activities such as sitting and reading a book, watching TV, working at a desk, etc, as well as napping or sleeping. The key attribute is that the person is engaging in only minimal actions that would tend to disturb source materials.

Section 4.3 (below) provides a more detailed description of the specific activities which will be included in each activity category during sample collection.

Data on Residual Source Levels

As noted above, the secondary objective of this effort is to obtain data on the relationship between LA levels in indoor air and in various potential residual sources, including indoor dust, outdoor soil, and ambient air.

Outdoor Ambient Air

Data on LA levels in ambient air are presently being collected at 14 stations in OU4, and it is expected these data will provide an adequate basis for assessing the contribution of outdoor air to indoor air. Thus, no additional sampling beyond the on-going monitoring program are needed.

Outdoor Soil Samples

Data on LA levels in pre-cleanup outdoor soil are available as part of the Contaminant Screening Survey (CSS) and (in some cases) the Pre-Design Inspection (PDI) performed at each cleanup property. While the post-cleanup pattern of residual VCS and LA in yard soil can be deduced from the property specific CSS, PDI, and removal design, a substantial level of effort is needed to estimate area-weighted average post-cleanup soil levels from this report. Therefore, supplemental data on the level and extent of residual soil contamination will be collected at all properties evaluated as part of this effort. This supplemental data will consist of three parts:

- A sketch of the yard that shows the location and size of any areas with visible vermiculite, along with an indication of the relative amount

- One multi-point composite soil sample collected from NSUA areas, to be analyzed by PLM-VE
- One composite sample that combines soils from all SUAs, to be analyzed by PLM-VE

These data will provide a sufficient characterization of residual outdoor soil levels at various categories of post-cleanup properties, and will support an assessment of whether residual VCS or LA in outdoor soil may pose a continuing source to indoor dust or air.

Indoor Dust

Data on pre-cleanup indoor dust levels are collected at each cleanup property as part of the Contaminant Screening Survey (CSS) or PDI, but post-cleanup dust samples are generally not collected, even when an indoor dust cleanup occurs. Therefore, in order to support the secondary objective of this sampling effort, indoor dust samples will be collected at all post-cleanup properties selected for inclusion. Dust samples will be collected from floors and other horizontal surfaces that may be disturbed by routine indoor activities. Dust samples will be collected using a microvacuum technique, as detailed in the Sampling and Analysis Plan for Indoor Dust (EPA 2003b).

Other Indoor Sources

As noted above, other residual sources that may contribute to LA in indoor air in post-cleanup properties includes things such as carpets, upholstery, air ducts, VI in enclosed spaces, etc. While there are too many independent variables to allow measurement and stratification of sampling locations based on all of these potential residual sources, it is important that the data collected at each property include a thorough documentation of all potential sources known to exist in the building. If a subset of properties is recognized as having higher indoor air levels of LA than most others, these data on residual sources may help form hypotheses about which residual sources are most likely to be responsible, which in turn may form the basis for a focused follow-up investigation, as may be judged necessary to support decision-making.

3.4. Define the Bounds of the Study

Spatial Bounds

The spatial bounds of this study are restricted to properties located within OU4 of the Libby Superfund site. This OU includes most current residential and commercial properties in the community. Note, however, that the results of this study may also be useful in assessing cleanup efficacy under similar conditions in other operable units at the site.

Temporal Bounds

Human health risk from exposure to LA in indoor air is related to the long-term average concentration in indoor air. Because the level of LA in indoor air may depend on factors that vary seasonally (indoor activity patterns, humidity, building ventilation rate, etc.) the data set needed for this effort should consist of multiple samples from each building (residence or workplace), spanning a range of time points and meteorological conditions (e.g., quarterly sampling). This will help ensure that reliable estimates of long-term average concentration may be computed from the individual short-term measurements.

3.5. Define the Decision Rule

Primary Decision Rule

For the primary objective of this effort (evaluation of cleanup efficacy), the decision rule is:

> If the level of risk to humans from exposure to indoor air at a post-cleanup location, when combined with the level of risk which applies to the same individuals from other applicable exposure pathways, does not exceed a cancer risk of 1E-04 or a non-cancer Hazard Quotient of 1.0, then risks at that property will be considered acceptable. If the total risk exceeds a cancer risk of 1E-04 or an HQ of 1.0, then the feasibility of further reducing exposure from either the indoor air pathway and/or the other applicable exposure pathways shall be assessed.

Secondary Decision Rule

For the secondary objective of this effort (development of a quantitative indoor air exposure model based on measures of LA in residual sources), the decision rule is:

> If the available data establish a clear relationship between long-term average indoor air levels and levels of LA in one or more residual sources, it will be concluded that development of a quantitative exposure model is appropriate and may be used to estimate exposure from indoor air at locations where no indoor air data have been collected. Conversely, if no apparent relationship between long-term indoor air levels and residual sources can be established, it will be concluded that predictive approaches are not feasible at this site, and that other strategies for evaluation of exposure from indoor air are needed.

3.6. Define the Acceptable Limits on Decision Errors

Primary Decision Rule

In making decisions about the long-term average concentration of LA in indoor air and the level of health risk associated with that exposure, two types of decision errors are possible:

- A Type I (false negative) decision error would occur if a risk manager decides that exposure to indoor air is not of significant health concern, when in fact it is of concern.

- A Type II (false positive) decision error would occur if a risk manager decides that exposure to indoor air is above a level of concern, when in fact it is not.

EPA is most concerned about guarding against the occurrence of Type I errors, since an error of this type may leave humans exposed to unacceptable levels of LA in indoor air. For this reason, it is anticipated that decisions regarding this pathway will be based not only on the best estimate of the long term average concentration, but will also consider the 95% upper confidence limit (UCL) of the long-term average concentration. Use of the UCL to estimate exposure and risk helps account for limitations in the data, and provides a margin of safety in the risk calculations, ensuring that risk estimates are unlikely to be too low.

EPA is also concerned with the probability of making Type II (false positive) decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. For the purposes of this effort, the strategy adopted for controlling Type II errors is to ensure that if the exposure estimate based on the 95% UCL is above EPA's level of concern for this pathway, then the UCL is not larger than 3-times the best estimate of the mean. If the 95% UCL is at or above the range that is of potential concern, and the UCL is greater than 3 times the best estimate of the mean, then it will be concluded that there is a substantial probability of a Type II error and that more data may be needed to strengthen decision-making.

Secondary Decision Rule

In determining whether the data are adequate to support development of a quantitative exposure model for indoor air, the key issue is how accurately the model can predict the observed long-term average indoor air concentration as a function of the data available on the potential source terms. The general form of the model would be as follows:

C(indoor air) = k1·(Outdoor air) + k2·(Indoor dust) + k3·(Outdoor soil) + k4·(Other sources)

Although final evaluations can not be made until a model is developed and assessed, if predicted concentration in indoor air are found to be within 2-fold of observed long-term average values at 90% or more of evaluated properties, the model will be considered to be appropriate for supporting risk management decision making. If the predictive accuracy of the model does not achieve this level, then the model will be used primarily as a screening tool rather than to support final decisions.

3.7. Optimize the Design

Limiting the Uncertainty in Estimates of Long-Term Average Concentration

The method used to compute the UCL of a set of indoor air samples depends on the statistical properties of the data set. At present, data on the distributional form and between-sample variability are limited. Figure 3-1 shows log-probability plots of available personal indoor air samples stratified by activity level (active vs routine). As seen, the data are moderately well characterized by a lognormal distribution, and the value of sigma appears to be in the range of about 2. Note that these data are not stratified by level of LA in source materials, so actual values of sigma may be somewhat lower.

If it is assumed that the variability between different samples is likely to be approximately lognormal, then the data set collected from a location or a set of similar locations may be approximated by a mixed Poisson lognormal (PLN) distribution. Statistical procedures are available to estimate the parameters of the underlying lognormal distribution (Haas et al. 1999), and these fitted parameters may be used to compute the UCL of the mean using the approach for lognormal data sets described in EPA 1992. Based on this approach, the ratio of the UCL to the mean of a data set (an indication of the statistical uncertainty in the data) is given by:

$$\frac{UCL}{Mean} = \exp\left(\sigma H / \sqrt{(n-1)}\right)$$

where:

σ = log standard deviation of the measured values
H = statistic described in USEPA (1992)
n = number of samples

Figure 3-2 illustrates the ratio of the UCL to the mean as a function of n for an assumed value of σ of 2.0. As seen, the ratio (a measure of uncertainty) approaches a value of about 2 as the number of samples approaches about 80-100, and continues to decline slowly as the number of samples increases. Based on this analysis, it is expected that if a total of about 80-100 samples per property type were collected, the uncertainty in the average concentration would be limited to less than a factor of 3, and that collection of additional samples would result in only minor decreases in uncertainty. Because four samples will be collected per property (on a quarterly basis), if there were 20 properties per category, this would result in a total of 80 measurements, which should result in an acceptable limit on the width of the uncertainty bounds around the long-term average value.

Estimating the Required Analytical Sensitivity for Indoor Air

For the purposes of this effort, the analytical sensitivity of indoor air samples should be sufficient to ensure reliable detection and quantification if risks from indoor air approach or exceed a cancer risk of 1E-05 (1 in 100,000) or a non-cancer HQ of 0.1. The concentrations associated with these risk levels may be estimated as described below.

For cancer, a simplified equation for computing the risk associated with some specified concentration is:

Risk = C • TWF • UR

where:

Risk = risk of lung cancer or mesothelioma from the exposure being evaluated
C = long-term average concentration of asbestos (structures per cubic centimeter [s/cc])
TWF = time weighting factor (percent of full time that exposure occurs)
UR = unit risk for lifetime exposure

The concentration of concern associated with a specified risk level (1E-05) is then computed by rearranging the equation as follows:

Concentration of Concern = (1E-05) / (TWF • UR)

For planning purposes, it is conservatively assumed that the TWF for exposure to indoor air is 1.0. If exposure is less than 24 hours per day or less than a full lifetime, the target analytical sensitivity would be somewhat higher. Based on EPA's currently recommended risk model

(IRIS 2006), the unit risk factor for lifetime exposure is 0.23. Thus, the concentration of concern for LA in air would be about:

Concentration of concern (1E-05 risk level) = (1E-05) / (1 · 0.23) = 0.00004 s/cc

For non-cancer effects, the basic risk equation is:

HQ = C • (ET/24 • EF/365 • ED) / RfC

where:

HQ = hazard quotient (dimensionless)
C = long-term average concentration of asbestos in air (f/cc)
ET = exposure time (hrs/day)
EF = exposure frequency (days/yr)
ED = exposure duration (yrs)
RfC = Cumulative Reference concentration (f/cc-yrs)

However, at present, no RfC has been established for evaluating non-cancer effects from inhalation of LA, so it is not yet possible to compute an analogous level of concern for this endpoint. In the absence of data, it is tentatively assumed that the target analytical sensitivity that is adequate for evaluating cancer risk will also be sufficient for evaluating non-cancer risks. This assumption will be re-visited when an RfC is developed.

Because the personal air samples collected during this effort will be characterized by relatively low air volumes (10 L/min · 60 min/hr · 4 hrs = 2400 L), the number of grid openings that require analysis in order to achieve a target analytical sensitivity of 0.00004 s/cc is rather large (about 400 grid openings per sample). Recognizing that the total number of air samples to be analyzed as part of this program is about 640 (20 properties per soil category x 4 soil categories x 4 samples/property x 2 activity types per sampling event = 640), this poses a problem with regard to the practicability of implementing both the target sensitivity and the specified number of samples. For this reason, a compromise is needed either in the number of samples collected, or in the target sensitivity.

Figure 3-3 summarizes the results of an analysis using Monte Carlo simulation to determine whether it is better to compromise on sample number or analytical sensitivity. Three cases are shown:

Case	Number of samples per soil category per activity pattern	Sensitivity $(cc)^{-1}$
1	80	0.00004
2	20	0.00004
3	80	0.00016

All cases assume that the set of samples collected over time from each of the properties in a soil category may be combined into a single data set for the purposes of estimating the average concentration and the 95% UCL of the mean. The calculations also assume that between-sample variability is relatively large (GSD = 8), and that the average indoor air concentration is about 0.0005 total LA s/cc.

Case 1 assumes there are 80 samples per data set and each is analyzed to an analytical sensitivity of 0.00004 cc^{-1}. Case 2 evaluates the situation where analytical sensitivity is held constant, but the number of samples per soil category is reduced 4-fold (from 80 to 20). Case 3 evaluates the situation where the number of samples per soil category is held constant at 80, but the analytical sensitivity is increased 4-fold (from 0.00004 to 0.00016 cc^{-1}).

Figure 3-3 plots the distributions of the log of the ratio of the 95% UCL of the mean (calculated as detailed in Tech Memo 11) divided by the true mean. In this format, if the UCL were equal to the mean, the ratio would be 1.0 and the log would be zero. Thus, the ideal distribution of UCL values would have 5% of the distribution to the left of the vertical line at zero (i.e., the UCL is lower than the mean 5% of the time), and the distribution of UCL values to the right of the line would be as narrow as possible (to limit the occurrence of Type II errors). As seen, using Case 1 as the frame of reference, the effect of decreasing sample number (Case 2) results in a considerable increase in the width of the distribution of UCL values, while reducing the analytical sensitivity (Case 3) results in only a small increase in the distribution width. These results indicate that data quality would be substantially impaired by decreasing sample number, but only slightly impaired by increasing analytical sensitivity. For this reason, the required sensitivity for indoor air samples collected as part of this effort will be 0.00016 cc^{-1}, which will require analysis of about 100 grid openings per sample.

Estimating the Required Analytical Sensitivity for Indoor Dust

If a quantitative relationship between LA in indoor dust and in indoor air were established, this could be used to calculate a risk-based concentration of LA in indoor dust, and this could be used to select a target analytical sensitivity for dust. While screening level values for dust to air relationships are available from the literature (e.g., see USEPA 2003a), studies at Libby have not

yet provided any firm basis for identifying a reliable site-specific dust-to-air transfer factor. Thus, in the absence of such a risk-based approach, a target analytical sensitivity of 20 s/cm^2 is selected for dust samples collected during this effort. This value is at the low end of what is considered practical (requiring analysis of about 50-100 grid openings per sample). It is also suspected that dust levels below about 20 s/cm^2 are likely to be of relatively low concern as a source of indoor air contamination.

Refinements to the Design as Data are Collected

In accord with EPA's DQO process, it is expected that the indoor air monitoring program described in this document may be modified periodically as data are obtained. For example, if data suggest that the variability in concentrations over time is low, then EPA may decrease the number of samples collected over a specified period of time. Alternatively, if data suggest that the variability in concentrations is higher than expected, then additional samples may be added to better limit the uncertainty in the values. Similarly, the target analytical sensitivity may be either increased or decreased, depending on the detection frequency, mean values, and sample variability observed in initial samples results, and on the RfC value when it becomes available.

4.0 SAMPLING PROGRAM

This section provides brief summaries of SOPs and additional site-specific detail that may not be discussed in the SOPs. The site-specific procedure will be followed during this investigation. For additional information, field personnel will refer to the SOPs included in Appendix A. The site health and safety plan (HASP) should be consulted to determine health and safety protocols for performing site work. The SOPs and site-specific procedures included in Appendix A are listed below (CDM 2005a):

- Sample Custody (SOP 1-2)
- Packaging and Shipping of Environmental Samples (SOP 2-1)
- Guide to Handling of Investigation-Derived Waste (Modified SOP 2-2)
- Field Logbook Content and Control (SOP 4-1)
- Photographic Documentation of Field Activities (Modified SOP 4-2)
- Field Equipment Decontamination at Nonradioactive Sites (Modified SOP 4-5)
- Control of Measurement and Test Equipment (SOP 5-1)
- Sampling of Absetos Fibers in Air (EPA-LIBBY-01) (EPA 2001)
- SAP for Indoor Dust, Revision 0 (EPA 2003b)
- Site-Specific Standard Operating Procedures for Soil Sample Collection (CDM-Libby-05, Revision 1)
- Site-Specific Standard Operating Procedure for Semi-Quantitative Visual Estimation of Vermiculite in Soil (CDM-Libby-06, Revision 0)

Note that in the SOP for visual vermiculite (referenced above), there is wording included that states use of this SOP outside removal design is inappropriate…Page 4, 1st paragraph:

> *"Use of this SOP is inappropriate for any other application. Likewise, while the information gained during this effort will aid in identification of prospective properties that can be used during future activity-based sampling (ABS) efforts ,the sampling design presented here does not provide sufficient information necessary for selecting a property or portion of a property for ABS studies."*

- Therefore, we may need to mod this SOP or amend it.

The following sections are a summary of field activities that will be performed in accordance with this SAP by CDM during the outdoor ambient air sampling investigation.

4.1 Pre-Sampling Activities

Prior to beginning field activities, sampling locations will be selected, a field planning meeting will be conducted, and an inventory of supplies will be performed to determine procurements needs. The following sections discuss these pre-sampling activities.

4.1.1 Selection of Sampling Locations

As discussed in Section 3.3, it is important that the locations selected for evaluation be representative of the types and levels of residual sources that may remain at post-cleanup properties. The four main categories of property are:

Category	Pre-cleanup Soil Triggers	Post-cleanup NSUA Soil	
		VCS	PLM Detect (< 1%)
1	None	-	-
2		+	+
3	Outdoor soil	-	-
4		+	-

The target number of homes in each category is 20 (80 total).

To the extent possible, the 20 homes in each category should be selected to provide a reasonable spatial representation in OU4. In order to achieve this objective, the list of all post-cleanup properties in OU4 will first be stratified according to the four categories above, and then into three different sub-areas (north, central, and south), as shown in Figure 4-1 [new figure to be added]. CDM's Community Involvement Coordinator (CIC) staff will then contact the residents at the properties in each category in each sub-area to determine if they are willing to participate in this investigation. The objective is to obtain participation from 6-7 properties in each category from each area.

4.1.2 Community Coordination

Prior to the implementation of the sampling events described in this SAP, the owner of each property where sampling is proposed will be contacted to determine his/her desire to participate in this investigation. The property owner will be advised of the study's duration (at least a year and perhaps longer), sampling frequency, and will be informed of the importance of obtaining samples consistently over that extended time period. Access agreements will be obtained as required. A CDM CIC will contact each resident to describe the program and the potential impact to the resident (e.g., sample technicians visiting the property at regular intervals, the expected duration of the program).

4.1.3 Field Planning Meeting

Prior to beginning field activities, a field planning meeting will be conducted by the CDM field team leader and attended by the field staff and a member of the CDM quality assurance (QA) staff as well as EPA support scientists who were instrumental in study design development. The EPA Remedial Project Manger (RPM) will be notified of the date and time of the meeting. The agenda will be reviewed and approved by the QA staff and the health and safety officer prior to the meeting. The meeting will briefly discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required quality control (QC) measures
- Health and safety requirements
- Documents governing fieldwork that must be on site
- Any changes in the field plan documents

A written agenda, reviewed by the CDM QA staff, will be distributed and an attendance list signed. Copies of these documents are maintained in the project files, in the CDM Denver office. Additional meetings will be held when the documents governing fieldwork require it or when the scope of the assignment changes significantly.

The field team personnel will perform the following activities before and during field activities, as applicable:

- Review and understand this SAP and HASP
- Ensure that all sample analyses are scheduled through the laboratory
- Obtain required sample containers and other supplies
- Obtain and check field sampling equipment
- Obtain and maintain personal protective equipment (PPE)

4.1.4 Inventory and Procurement of Equipment and Supplies

The following equipment will be required for sampling activities, and any required equipment not already contained in the field equipment supply inventory will be procured prior to initiation of sampling activities:

- Field logbooks

- Indelible ink pens
- Digital camera
- Sample media: 0.8 um pore, 25 mm diameter MCE filter cassettes
- Sample paperwork and sample tags/labels
- Custody seals
- Zipper-top baggies
- Personal air sampling equipment
- PPE as required by the HASP

4.2 Sample Collection

4.2.1 Indoor Air Sampling

As discussed above, this effort is focused on collection of personal air samples rather than stationary air samples. Because wearing personal air samplers is not convenient, rather than requesting residents to submit to this approach, EPA will use CDM contractor staff to wear the personal air monitors. Participating residents will be required to leave the house during the time period of indoor sample collection.

Sampling will occur over an 8-hour time interval, divided into two sub-periods of 4-hours each with air samples collected separately for each 4-hour sub-period:

Period 1 (Sedentary Behaviors)
In the first 4-hour interval, the EPA staff person will engage in minimal physical activity. Initial activities shall include filling out all necessary paperwork and electronic reports associated with samples collection at the property. When all data recording requirements are satisfied, time may be spent reading or watching TV.

Period 2 (Active Behaviors)
In the second 4-hour interval, the contractor will engage in a standardized sequence ("script") of "active" behaviors, as detailed in Appendix B. This script is intended to capture a wide range of different activities that residents may engage in during normal living conditions. This includes things such as walking between rooms, sitting down on chairs and couches, simulated play with children or pets, active cleaning, etc.

Two personal air samples will be collected during each 4 hour sub-period, one to serve as a backup in case the other fails. Both monitors will draw air at a flow rate of 10 liters per minute (L/min) through a 385 square millimeter (mm^2) mixed cellulose ester (MCE) filter with 0.8 micrometer (um) pore size.

Indoor air sampling will be conducted in accordance with SOP EPA-LIBBY-01 (Appendix A), Revision 1, except where modified in this SAP.

4.2.2 Indoor Dust Sampling

At each property included in this effort, a set of two indoor dust samples will be collected using the standard microvacuum method used at the site as detailed in the SAP for Indoor Dust, Revision 0, August (EPA 2003b) (Appendix A). These samples will be composites of at least three templates (100 cm^2 each) collected floors and other horizontal surfaces in the same locations (rooms) where the EPA contractor performs the "active" and "sedentary" activities described above. Dust collection shall occur after the end of Period 1 but before the start of Period 2.

4.2.3 Outdoor Soil Sampling

At each property included in this effort, one composite soil sample will be collected to represent SUAs. Each SUA composite will include 2-4 discrete sub-samples per SUA (2 samples from small SUAs, and 3 or 4 from larger SUAs). Soil samples will be collected in accordance with the Site-Specific Standard Operating Procedures for Soil Sample Collection (CDM-Libby-05, Revision 1).

Comment [dw3]: This will mostly result in a composite sample with a small number of sub-samples? Is there a minimum number of sub-samples that should be collected?

At each property included in this effort, a second composite will be collected to represent NSUAs. Each NSUA composite sample will contain approximately 30 sub-sample samples, distributed approximately evenly throughout the NSUA portions of the property.

In addition, a sketch of the outdoor yard will be prepared that indicates the approximate locations and size of each SUA, the approximate location and level of any visible vermiculite in the yard, and the approximate locations of all sub-samples used to represent SUA and NSUA areas. This should be done in accord with the Site-Specific Standard Operating Procedure for Semi-Quantitative Visual Estimation of Vermiculite in Soil (CDM-Libby-06, Revision 0). When possible, outdoor soil sampling and observations should occur close to the time that the indoor air samples are collected. However, when necessary, the outdoor data may collected at a different time, since it is not expected that LA levels in outdoor soil vary substantially over time.

4.3 Field Documentation

Field documentation to be generated during this sampling study includes the following: logbooks, field sample data sheets (FSDSs), photographs, and sample custody documentation.

The following sections describe the types of documentation as well as how field documents will be corrected if errors occur and the process for documenting deviations from field procedures prescribed in this SAP.

4.3.1 Field Logbooks and Records

Field logbooks will be maintained in accordance with CDM SOP 4-1, Field Logbook Content and Control (Appendix A). This log is an accounting of activities at the Site and will note problems or deviations from the governing plans and observations relating to the sampling and analysis program. Field administrative staff will manage the logbooks and will send original field logbooks, as they are completed, to the CDM project file repository in Denver, Colorado for document control. A copy of each logbook will be maintained in the CDM office in Libby, Montana. In addition, copies of all field logbook entries will be provided to EPA and SRC at the conclusion of each sampling event. Electronic copies are suitable and will be placed in the project e-room within one week from the completion of each sampling event.

Detailed sampling notes will be recorded for each sample on an FSDS specific to the media being sampled (Appendix C). Field administrative staff will manage the FSDSs and will send copies to the CDM project file repository in Denver, Colorado for document control and a copy to the John A. Volpe National Transportation Systems Center (Volpe Center) for data entry required in the project database. Original FSDSs will be maintained in the CDM office in Libby, Montana. In addition, copies of all FSDS will be provided to EPA and SRC at the conclusion of each sampling event. Electronic copies are suitable and will be placed in the project e-room within one week from the completion of each sampling event.

4.3.2 Photographic Documentation

Photographs will be used to document areas where indoor activities are conducted and portions of the property were VCS exists outdoors. Photographic documentation will be recorded for each sampling location during the first collection event, with a digital camera in accordance with CDM SOP 4-2, Photographic Documentation of Field Activities (Appendix A), with the following site-specific modifications:

Section 5.2.2, General Guidelines for Still Photography – A slate is not required for each new roll of film. The information for the slate will be recorded in the field logbook (e.g., direction of the photograph, surrounding landmarks, etc.). All team members, as stated in the logbook, will be photographers and witnesses at the locations. Slates are not required for close-up photographs, and instead the required information can be listed in the digital photograph file

name. A color strip is not required for close-up or feature photographs.

File names will be in the format: last name of property owner_address_AAS_date

where:

IABS = Indoor Activity Based Sampling

Date = MM/DD/YY

Section 5.2.4, Photographic Documentation – The name of the laboratory, time and date of drop-off, and receipt of film are not required to be recorded for this project.

Section 3.3.2, Archive Procedures – Digital photographs will be archived on the CDM Libby Server (secure) with nightly backup. These files will be archived until project closeout, at which point project management will determine a long-term electronic file storage system.

4.3.3 Sample Labeling and Identification

Samples will be labeled with index identification numbers supplied by field administrative staff, and will be signed out by the sampling teams (i.e., controlled). For air and dust samples, one sample label will be placed on the sampling cassette. The sample identification number will also be written on the outside of the plastic bag used to hold the sampling cassette during transport. For soil samples, the index identification number will be written using a permanent ink marker on the outside of the one gallon zip-top plastic bag used to contain the sample.

Sample index identification numbers will identify the samples collected during this study by having the following format:

IN-#####

where: IN = Interior Activity Based Sampling
= a sequential five digit number

4.3.4 Field Sample Custody and Documentation

Sample custody and documentation will follow the requirements specified in CDM SOP 1-2, Sample Custody (Appendix A). All samples and sampling paper work will be relinquished to the sample coordinator at the end of each day. Field administrative staff will be responsible for

management of all field forms.

4.3.5 Corrections to and Deviations from Documentation

Logbook modification requirements are described in CDM SOP 4-1, Field Logbook Content and Control (Appendix A). For the logbooks, a single strikeout initial and date is required for documentation changes. The correct information should be entered in close proximity to the erroneous entry. These procedures will also be followed for the correction of any field form. All deviations from the guiding documents will be recorded on the Libby Asbestos Project Record of Modification Form (Appendix D). Any major deviations will be documented according to the CDM QA plan (CDM 2005c).

4.4 Chain-of-Custody Requirements

Chain-of custody (COC) procedures will follow the requirements as stated in CDM SOP 1-2, Sample Custody with modification (Appendix A). The COC record is used as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A complete COC record is required to accompany each shipment of samples.

At the end of each day, all samples will be relinquished to the sample coordinator by the sampling team following COC procedures. The sample coordinator will follow COC procedures to ensure proper sample custody between acceptance of the sample from the field teams to shipment to the laboratory.

Copies of all COCs for ambient air samples will be provided to EPA and SRC at the conclusion of each sampling event. Electronic copies are suitable and will be placed in the project e-Room within one week from the completion of each sampling event.

4.5 Equipment Decontamination

Equipment used to collect, handle, or measure soil samples will be decontaminated in accordance with CDM SOP 4-5, Field Equipment Decontamination at Nonradioactive Sites, with modifications. The following modifications to SOP 4-5 have been reviewed and approved:

Section 4.0, Required Equipment – Plastic sheeting will not be used during decontamination procedures. ASTM Type II water will not used. Rather locally available deionized (DI) water will be used.

Section 5.0, Procedures – Decontamination water will not be captured and will be discharged to the ground at the property.

Section 5.6, Waste Disposal – Decontamination water will not be captured and will not be packaged, labeled, or stored as investigation-derived waste 9IDW).

Decontamination procedures for soil sampling equipment will follow these steps:

- Remove all gross contamination with a plastic brush
- Use DI water and a plastic brush to wash each piece of equipment
- Remove excess water present on the equipment by shaking
- Use a paper towel to dry each piece of equipment
- Wrap dried equipment in aluminum foil

Once a week all soil sampling equipment will be cleaned using Alconox and DI water.

All air and dust sampling equipment will be wet-wiped immediately after use.

4.5 Handling Investigation Derived Waste

IDW at each property will consist of excess sample volume, spent decontamination supplies, and PPE. All IDW will be handled in accordance with CDM SOP 2-2 with Site-specific modifications, Guide to Handling of Investigation-Derived Waste, with modifications. The following modifications to SOP 2-2 have been reviewed and approved:

Section 5.2, Offsite Disposal – All spent sampling IDW (i.e., paper towels, respirator cartridges, etc.) will be collected in transparent garbage bags and marked "IDW" with an indelible marker. These bags will be placed in the sites asbestos waste stream.

4.6 QA/QC Activities

This section describes the QA/QC activities that will be conducted to ensure samples collected during this effort are of sufficient quality to meet the project DQOs.

4.6.1 Calibration and Control of Sampling Equipment

Prior to the collection of each air and dust sample, the sampling pump for that sample will be calibrated to the required flow rate by use of an adequately maintained secondary calibration

standard according to CDM SOP 5-1, Control of Measurement and Test Equipment (Appendix A) and EPA SOP 2015 (Appendix A).

4.6.2 Collection of QA/QC Field Samples

Four types of QA/QC samples will be collected as part of this investigation: lot blanks, field blanks, equipment blanks, and field duplicate samples:

Lot blanks (air/microvacuum) – Before samples are collected, two cassette lot blanks from each filter lot, for both 0.8 um air and microvacuum cassettes will be randomly selected and submitted for analysis. The lot blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. The entire batch of cassettes will be rejected if any asbestos fiber is detected on the lot blanks.

Field blanks (air/microvacuum) – One field blank will be collected at each property where sample collection occurs for air and microvacuum cassettes. One field blank, chosen at random, will be analyzed per week per filter type for this sampling study. If asbestos fibers are observed on a field blank, other field blanks collected during that week will be submitted for analysis to determine the potential impact on sample results. The field blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. The blanks will be collected at varying locations throughout the week (one collected at a different location on each day of the week). Field blanks are collected by opening the sample cassette to the ambient environment for 10 seconds then re-capping the sample cassette.

Equipment blanks (soil) – Soil samples will be collected using non-disposable equipment. Field equipment blanks are collected to determine if decontamination procedures used on field equipment are adequate to prevent cross-contamination of samples during sample collection. One equipment blank will be collected per week per team collecting soil samples. Field equipment blanks will be collected by placing silica sand in a decontaminated mixing bowl used to homogenize samples. The silica sand will be mixed in the bowl using decontaminated equipment that was used to collect soil samples. The silica sand will then be submitted as a sample for preparation and analytical analysis.

Field duplicates (soil) – Soil field duplicate samples will be collected at a rate of one per 20 (5%) of the non-QC field samples.

5.0 LABORATORY ANALYSIS AND REQUIREMENTS

All laboratories that analyze samples collected as part of this project must participate in and have satisfied the certification requirements in the last two proficiency examinations from the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NVLAP). The laboratory must also analyze performance evaluation samples when requested. These analyses must be performed before any samples are submitted to the laboratory to confirm the laboratory's capabilities and may be subsequently submitted at regular intervals. In addition, the laboratory must participate in the laboratory training program developed by the Libby laboratory team.

5.1 Analytical Methods

Air and Dust

All indoor air and indoor dust samples will be submitted to a subcontracted laboratory for analysis using the International Organization for Standardization (ISO) transmission electron microscopy (TEM) method 10312, also known as ISO 10312:1995(E) (CDM 2005c) with project specific modifications LB-000016, LB-000019, LB-000028, LB-000029, LB-000029a, LB-000030 (CDM 2003b). All asbestos structures (including not only Libby amphibole but all other asbestos types as well) having length greater than or equal to 0.5 um and an aspect ratio $\geq$ 3:1 will be recorded on the Libby site-specific laboratory data sheets and electronic deliverables.

As described in the latest version of laboratory modification LB-000029, the frequency for laboratory-based QC samples for TEM analysis is:

Lab blank = 4%
Recount same = 1%
Recount different = 2.5%
Re-preparation = 1%
Verified analysis = 1%
Inter-laboratory = 0.5%

Soil

All soil samples collected as part of this effort will be analyzed by polarized light microscopy (PLM) in accord with SOPs SRC-LIBBY-01 (Revision 2) and SRC-LIBBY-03 (Revision 2).

Sample Archival

All air and dust samples not planned for immediate analysis will be archived at the on-site project laboratory and held for potential future analysis, as directed by EPA.

All air and dust samples planned for immediate analysis will be distributed to the on-site project laboratory. Once analyzed, all samples will be will stored (archived) at the on-site laboratory under COC until further notice.

Aliquots of soil not sent for analysis will be archived at the Soil preparation Laboratory in accord with standard practice..

5.2 Analytical Sensitivity for TEM Analyses

Indoor Air Samples

As discussed in Section 3.1 (above), the target analytical sensitivity for indoor air samples is 0.00004 s/cc. In the event of sample loading or other issues where a sensitivity of 0.00004 s/cc can not be achieved, the laboratory may report a sample result with a higher (poorer) sensitivity only after consultation with EPA project personnel.

Indoor Dust Samples

The target analytical sensitivity for indoor dust samples collected as part of this effort will be 50 per cm^2. This level is sufficient that it will allow reasonable quantification of dust concentration across the wide range of values (from <50 up to a maximum of 5,000 s/cm^2) expected to exist in the various residences.

5.3 Holding Times

No preservation requirements or holding times are established for air samples collected for asbestos analysis.

5.4 Laboratory Custody Procedures and Documentation

Laboratory custody procedures are provided in the laboratory's QA management plan, which are approved by CDM as part of the laboratory procurement process. Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples. This inspection will include verifying sample integrity. The enclosed COC

records will be cross-referenced with all of the samples in the shipment. The laboratory custodian will sign these records and provide copies for placement in the project files. The sample custodian may continue the COC record process by assigning a unique laboratory number to each sample on receipt. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the laboratory's responsibility to maintain internal logbooks and records throughout sample preparation, analysis, and data reporting.

5.5 Documentation and Records

Data reports will be submitted to the CDM laboratory coordinator and include a case narrative that briefly describes the number of samples, the analyses, and any analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include signed COC forms, analytical data summary report pages, and a summary of QC sample results and raw data, where applicable. Raw data are to consist of instrument preparation and calibration logs, instrument printouts of field sample results, QC sample results, calibration and maintenance records, COC check in and tracking, raw data count sheets, spectra, micrographic photos, and diffraction patterns. All original data reports will be filed in the CDM project repository in Denver, Colorado. The laboratory also will provide an electronic copy of the data to the laboratory coordinator and others as directed by CDM.

5.6 Data Management

Sample results data will be delivered to the Volpe Center and CDM's Cambridge office both in hard copy and as an electronic data deliverable (EDD). Electronic copies of all project deliverables, including graphics, will be filed by project number. Electronic files will be routinely backed up and archived.

All results, field data sheet information, and survey forms will be maintained in the Libby project database managed by the Volpe Center.

6.0 ASSESSMENT AND OVERSIGHT

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities. Assessment, oversight reports, and response actions are discussed below.

6.1 Assessments

Performance assessments are quantitative checks on the quality of a measurement system and are appropriate to analytical work. Performance assessments for the laboratories may be accomplished by submitting reference material as blind reference (or performance evaluation) samples. These assessment samples are samples with known concentrations that are submitted to the laboratories without informing the laboratories that they are performance samples. Laboratory audits may be conducted upon request from the EPA RPM or Volpe Center PM.

System assessments are qualitative reviews of different aspects of project work to check on the use of appropriate QC measures and the functioning of the QA system. Project assessments will be performed under the direction of the QA managers, who report directly to the CDM president. Quality Procedure 6.2, as defined in the CDM QA Manual (CDM 2005d), defines CDM 's corporate assessments, procedures, and requirements. Due to the amount of sampling and the duration of the Libby project, both a field audit and an office audit are scheduled for the Site annually.

6.2 Response Actions

Response actions will be implemented on a case-by-case basis to correct quality problems. Minor response actions taken in the field to immediately correct a quality problem will be documented in the applicable field logbook and a verbal report will be provided to the CDM PM. For verbal reports, the CDM PM will complete a communication log to document the response actions were relayed to him/her. Major response actions taken in the field will be approved by the CDM PM, the EPA RPM, and Volpe PM prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. Quality problems that cannot be corrected quickly through routine procedures may require implementation of a corrective action request (CAR) form.

All formal response actions will be submitted to either CDM 's QA manager and/or project QA coordinator for review and issuance. CDM 's PM or local QA coordinator will notify the QA

manager when quality problems arise that may require a formal response action. CAR forms will be completed according to Quality Procedure 8.1 of the CDM QA Manual (CDM 2005d). In addition, when modifications to this specific SAP are required, either for field or laboratory activities, a Libby Asbestos Project Record of Modification Form (Appendix C) must be completed.

6.3 Reports to Management

QA reports will be provided to management whenever quality problems are encountered. Field staff will note any quality problems on field data sheets, or in field logbooks. CDM 's PM will inform the project QA coordinator upon encountering quality issues that cannot be immediately corrected. Weekly reports and change request forms are not required for this work assignment. Monthly QA reports will be submitted to CDM 's QA manager by the project QA coordinator.

Topics to be summarized regularly may include but not be limited to:

- Document technical and QA reviews that have been conducted
- Activities and general program status
- Project meetings
- Corrective action activities
- Any unresolved problem
- Any significant QA/QC problems not included above

7.0 DATA VALIDATION AND USABILITY

Laboratory results will be reviewed for compliance with project objectives. Data validation and evaluation are discussed in Sections 7.1 and 7.2, respectively.

7.1 Data Review, Validation, and Verification Requirements

No formal data validation for these media is currently required of CDM. At the request of Volpe Center, CDM will validate data submitted by analytical laboratories. Data validation consists of examining the sample data package(s) against pre-determined standardized requirements. The validator may examine, as appropriate, the reported results, QC summaries, case narratives, COC information, raw data, initial and continuing instrument calibration, and other reported information to determine the accuracy and completeness of the data package. During this process, the validator will verify that the analytical methodologies were followed and QC requirements were met. The validator may recalculate selected analytical results to verify the accuracy of the reported information. Analytical results will then be qualified as necessary.

Data verification includes checking that results have been transferred correctly from laboratory data printouts to the laboratory report and to the EDD. Data verification for this project is primarily performed as a function of built-in quality control checks in the Libby project database when data is uploaded. However, the sample coordinator will notify the laboratories and the project database manager (Mr. Mark Raney, Volpe Center) of any discrepancies found during data usage.

7.2 Reconciliation with Data Quality Objectives

Once data has been generated, CDM evaluates data to determine if DQOs were achieved. This achievement will be discussed in the measurement report, including the data and any deviations to this SAP. Sample data will be maintained in a Microsoft Access database. Laboratory QC sample data will be stored in hard copy (in the project files) and in a separate database.

8.0 PROJECT SCHEDULE

9.0 REFERENCES

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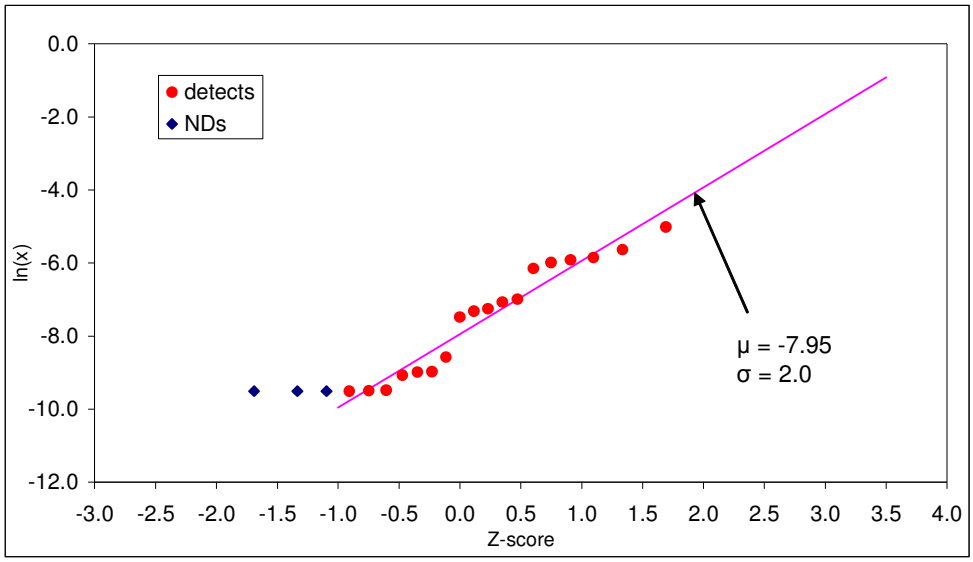
FIGURE 3-1
LOG-PROBABILITY PLOTS OF PERSONAL INDOOR AIR SAMPLES

Panel A: Routine Activity



Panel B: Active Cleaning

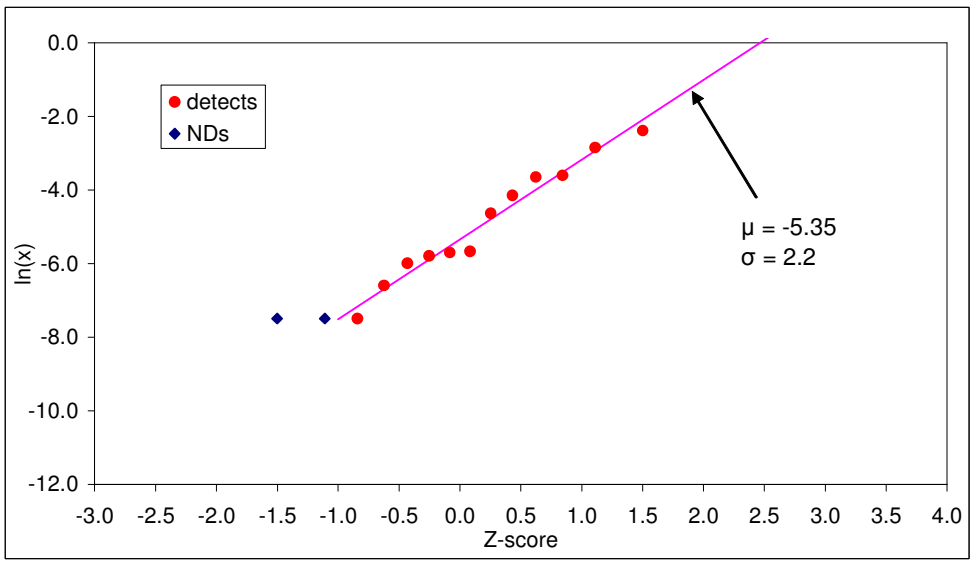


FIGURE 3-2
EXAMPLE UNCERTAINTY IN THE MEAN
OF A LOGNORMAL DATA SET WITH σ = 2.0

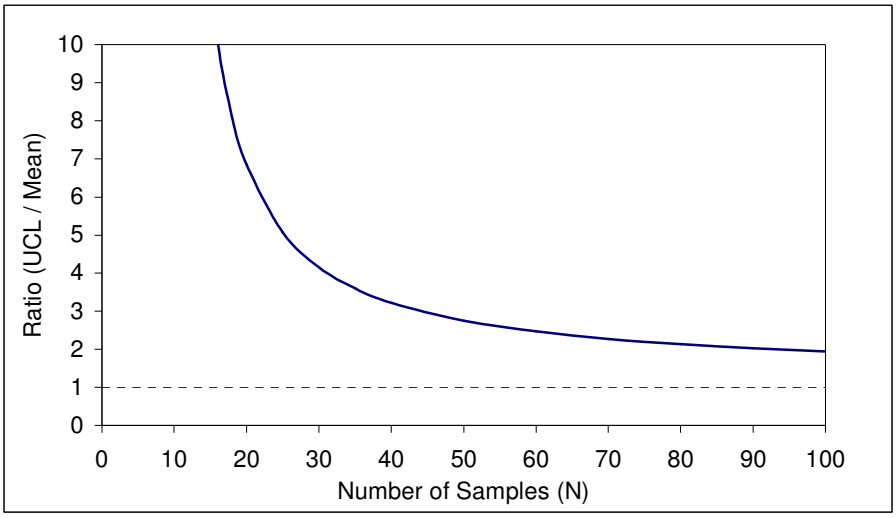


FIGURE 3-3
EFFECT OF DECREASING SAMPLE NUMBER OR
INCREASING ANALYTICAL SENSITIVITY ON DATA QUALITY

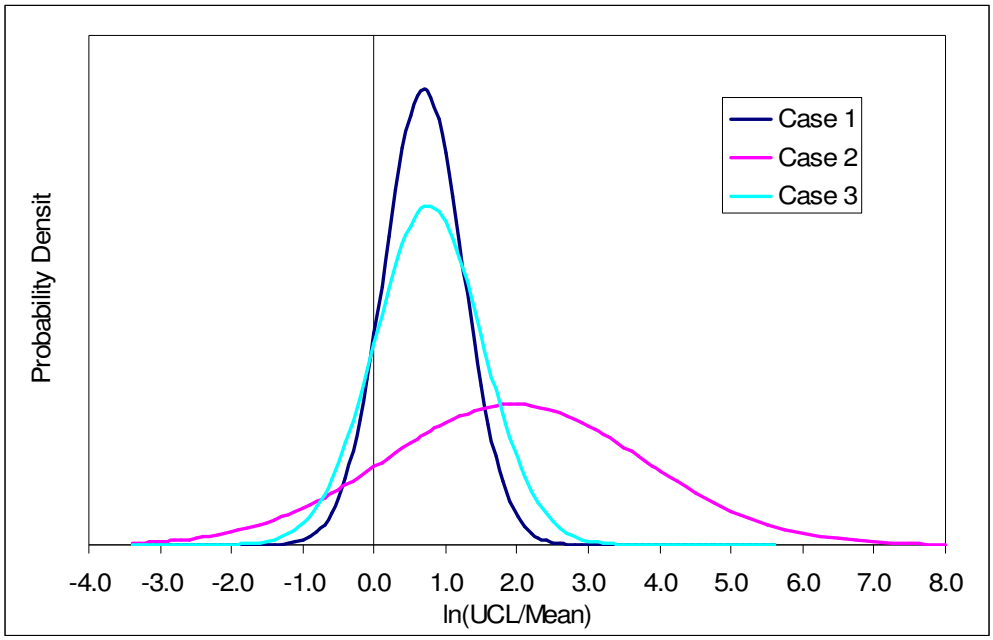


TABLE 3-1
INDOOR AIR VALUES STRATIFIED BY COLLECTION METHOD,
ACTIVITY TYPE, AND DUST LEVEL

Dust Level	Statistic	Dust Values	Rountine		Active	
			Personal	Stationary	Personal	Stationary
All	N	32	21	24	14	14
	Det Freq	66%	86%	63%	86%	57%
	Mean	429	1.2E-03	1.4E-04	1.7E-02	4.0E-03
	Stdev	1480	1.7E-03	1.7E-04	2.7E-02	9.6E-03
Low	N	15	9	12	4	4
	Det Freq	27%	88%	58%	100%	100%
	Mean	3	1.5E-03	1.3E-04	1.6E-02	3.0E-03
	Stdev	6	2.1E-03	1.7E-04	1.3E-02	2.2E-03
Med	N	11	8	8	5	5
	Det Freq	100%	75%	75%	60%	40%
	Mean	74	1.0E-03	1.5E-04	4.5E-03	7.5E-03
	Stdev	53	1.4E-03	1.5E-04	6.6E-03	1.6E-02
High	N	6	4	4	5	5
	Det Freq	100%	100%	50%	100%	40%
	Mean	2147	6.9E-04	1.5E-04	3.2E-02	1.4E-03
	Stdev	3036	1.2E-03	2.4E-04	4.2E-02	2.1E-03